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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

Reserve

WASHINGTON, D. C.

February 1, 1933

To Experiment Station
and State Entomologists:

(NOT FOR PUBLICATION)

MEMORANDUM RE MEANS OF ELIMINATING HARMFUL INSECTICIDAL
RESIDUES IN CONNECTION WITH VEGETABLES, SMALL FRUITS,
AND TOBACCO

A letter addressed by the Department to State entomologists, State agricultural colleges, experiment stations, and extension services under date of January 20, 1933, a copy of which has already been mailed to you from the Bureau of Entomology, discusses the present situation as to spray residue with special reference to the lead residue resulting from using lead arsenate, and certain problems of residue on leafy vegetables. This letter was supplemental to a letter of July 6, 1932, stressing the danger to human health from excessive arsenical residues and the similar risk from inorganic fluorine compounds.

The letter of January 20, 1933, urges all technical and extension agencies concerned to endeavor to secure the adoption, by growers, of spray schedules and methods of application recommended by the proper State and Federal agencies. It indicates also that several bureaus of this Department will supply additional and more detailed information on spray residue problems both as to schedules and effective methods of residue removal. In compliance with this promise, the Bureau of Entomology has drafted two memoranda in relation to the spray residue problems, one dealing specifically with codling moth control and the other dealing with vegetable crops, certain small fruits, and tobacco. The recommendations in these memoranda are based on conferences with the Bureau's station leaders in these two fields of work, and are, therefore, a report of the experience and information of the Bureau. These statements necessarily are subject to modification to meet varying field conditions and the results of studies now in progress.

The growing acuteness of the residue problem makes it imperative that the Bureau of Entomology and State agencies modify their recommendations on pest control in relation to vegetable crops in order to eliminate the possibility of poisonous residues reaching the consumer. It is appreciated that there is no complete substitute immediately available for the arsenicals and other compounds involving objectionable residues now utilized in the control of certain insects which attack leafy and other vegetable crops such as cabbage, lettuce, etc., and beans, squash, peppers, etc., and also such crops as small fruits and tobacco.

It is believed that the use of lead arsenate is not necessary on such crops, and that other arsenicals can be employed in conjunction with pyrethrum or like materials, and thus eliminate the lead factor and reduce other dangerous

residues to a minimum and yet secure good control of the pests concerned. While many non-lead arsenicals have been tested in recent years, there are others which have promise, and the Bureau of Entomology in cooperation with the Bureau of Chemistry and Soils proposes immediately to undertake field and laboratory tests in the hope that some of these may prove a satisfactory substitute for lead arsenate. Of the non-lead arsenicals now in use, the following are more or less commonly employed on vegetable or truck crops:

Paris green apparently is more toxic to more truck-crop insects than lead arsenate or calcium arsenate. Objections to its use, however, are based on the fact that it is more likely to cause plant injury than are other arsenicals. In fact, experience has shown that even where careful applications have been made certain combinations of climatic factors following treatment may cause some plant injury.

Calcium arsenate also under certain conditions causes plant injury, and apparently is not so toxic to certain species of insects as is either lead arsenate or Paris green.

Magnesium arsenate has proven of distinct value as an insecticide for beans but is not satisfactory for general truck-crop pests because of comparatively low toxicity and crop or foliage injury.

CONTROL RECOMMENDATIONS

The recommendations given herein for the control of pests which attack crops such as cabbage, cauliflower, broccoli, collards and the like, squash, peppers, strawberries, and tobacco are based on our present knowledge of their control with the elimination of lead arsenate from the spray schedule. These recommendations are necessarily tentative, and will be subject to modification with the progress of investigations now under way.

Spray and Dust Mixtures

Dusts

Paris green	1 lb.
Hydrated lime	10 lbs.
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Calcium arsenate	1 lb.
Hydrated lime or dusting sulphur	5 lbs.

Spray

Paris green	1 lb.
Hydrated lime	4 lbs.
Water	50 gals.
Sticker or spreader	

Pyrethrum dusts may be used undiluted or diluted with equal parts of tobacco dust, sulphur, or other carrier. The commercial pyrethrum extracts vary as to pyrethrum content, and the directions as given by the manufacturer should be used as a basis for the dilution of these materials.

SUGGESTIONS RE USE OF INSECTICIDES

Particular emphasis should be placed on the use of spray and dust equipment which will cover the plant with a light, even coating of the poison. If the insect feeds primarily on the undersides of the leaves, the dust or spray nozzles should be so arranged that the greater part of the poison will reach the undersides of the plant. The use of the "shaker method" for applying insecticides in the dust form, such as the can and sack, is not to be recommended. So applied, the distribution is irregular--too much or too little--and also wasteful of material.

It will be necessary to modify treatments to conform with climatic conditions and cropping practices in the different producing regions. Emphasis should be placed on the control of an insect infestation in its early stages of development. The object should be the keeping down of infestations rather than attempt to control the pest after the crop has become heavily infested.

Sprays or dusts consisting of arsenicals, or other materials recognized as poisonous to man, should not be applied to the crop when foliage or fruit (that will be marketed) is on the plant unless the residues can be removed by washing.

To protect the crop after it has reached a stage of growth which will make the use of arsenicals dangerous to the health of the consumer, pyrethrum, either in the form of a spray or a dust, is recommended.

CONTROL OF IMPORTANT CROP PESTS

No attempt will be made here to outline control measures for all crops, but simply to give the recommendations the Bureau will issue in the effort to eliminate lead residues and reduce to a minimum arsenical residue on the consumed or market product of crops generally affected.

Cole-Crop Pests

Insecticidal treatment.--For the control of the common cabbage worm, cabbage looper, cabbage webworm, and diamond-back moth on such crops as cabbage, cauliflower, broccoli, kale, collards, and related crops, Paris green, either in the form of a dust or a spray, is recommended. Experience would indicate that calcium arsenate is not so toxic to these pests as is Paris green.

While no definite information is available as to the exact time when arsenical treatments should stop so as to preclude the possibility of any arsenical residue being on the marketed product, information along this line is being obtained as rapidly as possible. Several factors are involved here, the primary one being weathering or the effect of rainfall on the removal of the residue from the plant. This varies with the season. Of the crops mentioned above, it would appear that cabbage could be treated for a longer period than any of the others. The loose-leaf variety of cabbage, such as is grown in the southern producing areas, can not, however, be treated as close to harvest time as can the tight-headed varieties grown in the North.

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Since with cauliflower the leaves surrounding the head are often used for food, the treatment of the crop should be so regulated that these leaves do not bear a poisonous residue.

With respect to broccoli, kale, or collards, very little information is available as to when it is safe, if ever, to use arsenicals. Little or no danger, however, will result from the treatment of these crops in the seedling stage to protect them particularly from webworm and flea beetle damage.

Farm or cultural practices.---Emphasis should be placed on the thorough cleaning up of crop remnants after harvest. It has been observed, in the southern producing areas particularly, that fields of harvested cabbage and other similar crops serve as a source of infestation to the new plantings.

Celery Insects

Celery leaf tier.---The celery leaf tier is the major pest of celery in the Florida producing area, and also periodically becomes troublesome in the North and in California. This pest can be controlled by careful treatments with pyrethrum dust, the dust being mixed with an equal quantity by volume of tobacco dust or hydrated lime. Tobacco dust has proven more satisfactory than other materials as a diluent and is recommended. The treatment consists of making two applications within a period of one-half hour. The object of making the two treatments within such a period is that the second application is to kill those worms which have moved from the web as a result of the first treatment. Approximately 25 lbs. of the mixture per acre are necessary for each application. Except under unusual conditions in the Florida area, one treatment, that is, two applications at a half-hour interval, is sufficient to protect any one given area of celery.

Arsenicals are not satisfactory as a control for this pest, and are not to be recommended.

Celery looper.---Several species of loopers attack celery. In Florida these pests are held in check by a bacterial disease, and observations so far would indicate that ordinarily no artificial control measures are necessary. These pests succumb readily to treatments of pyrethrum powder as recommended for the celery leaf tier, and arsenical applications are not necessary.

Cutworms.---The use of an arsenical bait is the only practicable means for the control of the majority of the species of cutworms attacking celery. The risk from poison residue can be eliminated by the distribution of one of the standard cutworm baits between the rows, provided care is taken to keep the bait from falling on the plants.

Cultural practice.---Under some conditions, the cleaning up of the crop refuse after harvest is valuable in pest control, particularly of the celery leaf tier.

Squash Insects

Melon and pickle worms.---The melon worm and the pickle worm may be satis-

factorily controlled in North and South Carolina by dusting with a mixture composed of 1 pound of calcium arsenate and 5 pounds of finely ground sulphur. Better coverage may be obtained by the substitution of 1 pound of wheat flour for a pound of the sulphur. The treatments should begin when the larvae first appear on the leaf buds of the squash, which may be a week or ten days after the plants appear above ground. The treatments should be given at 10-day intervals until the first fruit appears. The rate of application will depend upon the size of the plants being dusted, and will range from 15 to 30 lbs. per acre per application. Care should be exercised to see that the growing tips of the plant are well covered with the poison.

After the crop has started to produce fruit, a mixture composed of 1 part of pyrethrum and 3 parts by weight of finely ground dusting sulphur is recommended; 20 to 25 pounds of this mixture should be used for each application per acre. Dusting sulphur is recommended here instead of tobacco dust, as sulphur alone has given partial control of the melon worm and pickle worm.

A bellows-type duster has proven more satisfactory for the treatment of the squash crop than the rotary type because of the method of planting and also the necessity of applying the material directly to the growing tips of the plant.

Pepper Insects

Pepper weevil.---The pepper weevil can be controlled by treating the crop with undiluted calcium arsenate. However, such treatment necessitates washing of the peppers with a dilute solution of hydrochloric acid to remove the residue.

Lettuce and Spinach Insects

There are several leaf-feeding forms which may attack lettuce and spinach and, on occasions, cause considerable damage. Satisfactory control measures apparently are not available. The information at hand does not indicate whether arsenicals can be used on these crops in any stage of their development. Pyrethrum is recommended as a substitute for the arsenicals in order to safeguard the health of the consumer.

In the application of poisoned baits for cutworm control, every care should be exercised to see that the bait does not lodge within the heads of the plants.

Bean Insects

Mexican bean beetle.---The best control for the bean beetle is spraying with magnesium arsenate, the spray mixture being used at the rate of 2 pounds to 100 gallons of water or 1 ounce to 3 gallons. Proper treatment when beetles are numerous results in an excellent crop of beans, whereas untreated fields are often completely destroyed. The poison must reach the undersides of the leaves, and the spraying must be done thoroughly. Begin spraying when the adults

are found in the field or the eggs of the beetle become numerous on the undersides of the leaves. One to three, sometimes four, applications are required, depending on the abundance of the insect.

It is important that all applications of magnesium arsenate to snap beans should stop when the pods begin to form. If later treatments prove necessary, pyrethrum extracts should be used, care being taken to reach the insect with the spray.

As important as thorough spraying is the destruction of the crop remains after harvest. Plow under all plant remnants at least 6 inches deep.

Dusting may be practiced but does not give as good results as spraying; and when calcium arsenate mixtures are used, plant injury often results. Lead arsenate should never be used on bean foliage. Serious injury and reductions in yield often result from its use, even with Bordeaux mixture.

Other leaf-feeding bean insects, particularly the bean leaf beetle, the green clover worm, and flea beetles, may usually be controlled by following the above recommendations.

See Farmers' Bulletin 1624 for detailed instructions.

Strawberry Insects

Strawberry weevil.--A careful study of the hibernation habits of the strawberry weevil in North Carolina shows that the destruction of the weevil by burning over its hibernating areas is a most effective means of reducing losses from attacks of this pest.

Such burning is necessary only over areas within 100 feet of the strawberry field, as observations have shown that 97 per cent of all weevils hibernate within 100 feet of the cultivated areas. The burning should be carried on in the winter and not in spring, and every precaution should be taken to prevent such fire from getting out of control.

When the burning method can not be applied, satisfactory control of the strawberry weevil may be obtained by dusting with a mixture consisting of calcium arsenate 1 pound and sulphur 5 pounds. The first application should be made as soon as the weevil appears in the field. The rate of application will range from 10 to 30 pounds per application, depending upon the density of the strawberry planting. Ordinarily two applications are all that are necessary to protect the early fruit. All applications of poison dusts should be discontinued at least three weeks prior to the ripening of the first berries. Where a long bearing season obtains, the treatment with an arsenical poison after this period constitutes a menace to the health of the consumer.

Vegetable Weevil

The vegetable weevil is an important pest of vegetable crops in California and the Gulf region. The following methods are recommended for its control:

1. Cultivation during the period when the insects are in the ground.
2. Crop rotation to avoid building up infestations through continuous cropping with favorite hosts.
3. Poison baits scattered between rows and on headlands as soon as the first damage is noticed in the spring.
4. Field sanitation. All rubbish and weeds where the insect may find shelter during inactive periods should be cleaned up so that the ground is bare during this time.
5. The treatment of crop remnants with arsenicals after the crop is harvested is advocated as a means of reducing weevil populations.

Tobacco Insects

Although tobacco is not a food, from the evidence at hand it would appear that arsenical or other poison residues on tobacco are a menace to the consumer, and every precaution should be taken to keep the residue on tobacco to a minimum.

Tobacco hornworm.—Tobacco hornworms may be controlled by dusting with undiluted calcium arsenate or Paris green, the dust being applied at the rate of 4 pounds of calcium arsenate or 1 pound of Paris green per acre. Special care is necessary in the manipulation of the duster in order to obtain a good coverage of the plant and keep the rate of application down to a minimum.

Cultural and other controls.—Fall plowing is very effective against the overwintering form or pupa of the hornworm.

Hand picking of the worms where the acreage is limited can be practiced to advantage, especially when the cost of labor is not high.

As a control for hornworm moths, some promising leads have been obtained with the use of a special feeder containing poison bait consisting of amyl salicylate as an attractant used in conjunction with tartar emetic as a poison. For further information on this method of control consult the Bureau of Entomology.

C. L. Marlatt
Chief of Bureau

1. Infestation during the period when the insects are in the ground.
2. The rotation is avoided by infestation through cuttings growing with favorite hosts.
3. Potatoes being scattered between trees and on headlands as soon as the first damage is noticed in the spring.
4. Field sanitation. All rubbish and weeds where the insects lay their eggs during inactive periods should be cleaned up so that the ground is bare during this time.
5. The treatment of crop remnants with arsenicals after the crop is harvested is advocated as a means of reducing weevil populations.

Tobacco Insects

Although tobacco is not a food crop, the evidence of pest it would be near that of a food crop. In fact, tobacco is a source of food for many insects, and every grower should be kept on guard against its infestation.

Tobacco Rootworm - Tobacco rootworms are controlled by digging with a shallow trowel or fork in the ground, the first being applied to the roots of a tobacco plant or 1 pound of this ground per acre. Special care is necessary in the application of the dust in order to obtain a good coverage of the plant and keep the rate of application down to a minimum.

Colorado potato beetle - Fall plowing is very effective against the overwintering form of the beetle.

Hand picking of the roots where the source is limited can be practiced to advantage, especially when the cost of labor is not high.

A control for beetles which some promising leads have been obtained with the use of a special weather resistant dust consisting of a very fine material in an attractant used in combination with a contact insecticide. For further information on this method of control consult the Bureau of Entomology.

E. J. Hurlbut
Chief of Bureau